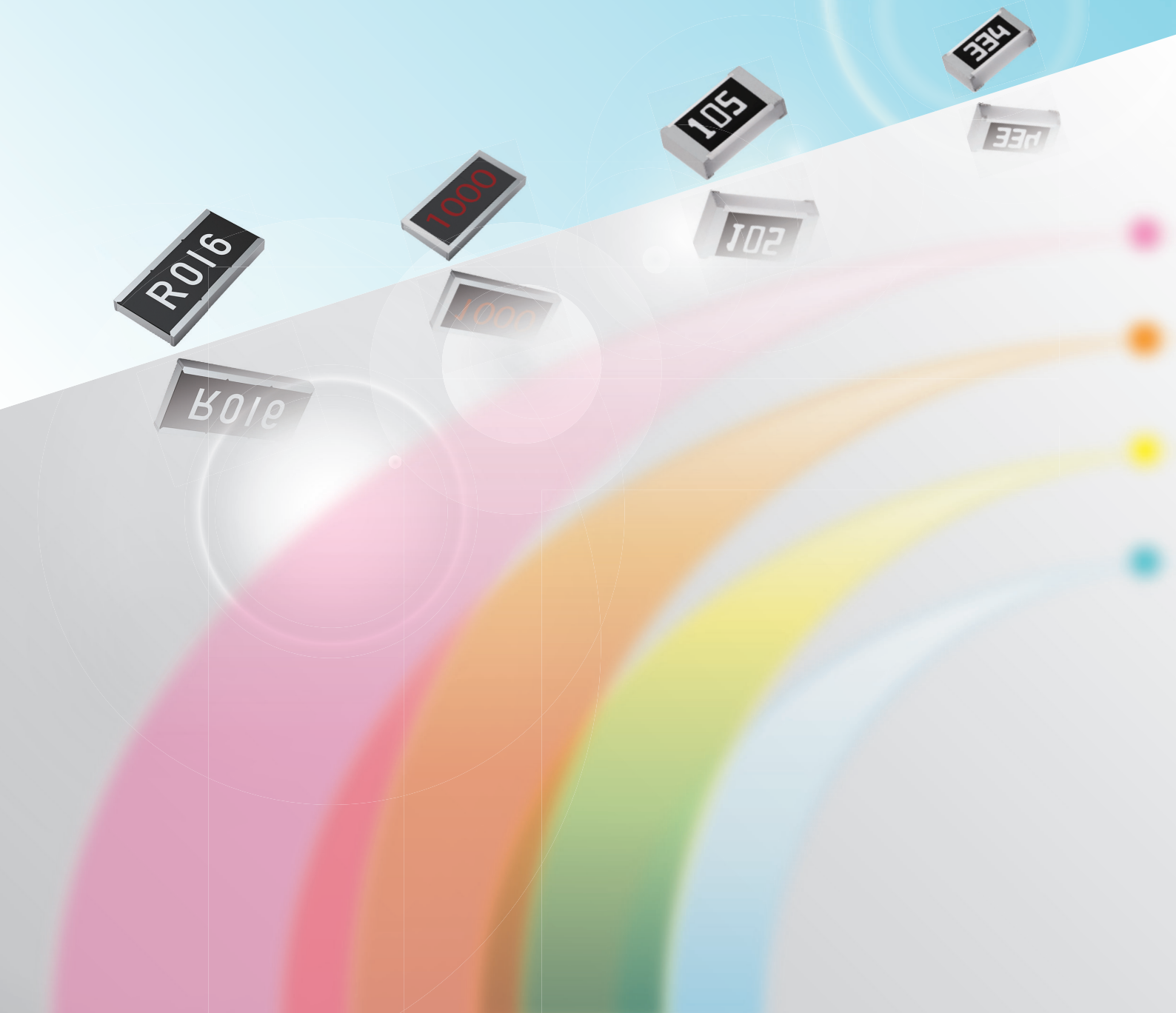
Panasonic
INDUSTRY

High performance chip resistor

2021.11

- High precision chip resistors
- High temperature chip resistors
- Anti-sulfurated chip resistors
- Current sensing chip resistors
- Small & High power chip resistors



Guidelines and precautions regarding the technical information and use of our products described in this online catalog.

- If you want to use our products described in this online catalog for applications requiring special qualities or reliability, or for applications where the failure or malfunction of the products may directly jeopardize human life or potentially cause personal injury (e.g. aircraft and aerospace equipment, traffic and transportation equipment, combustion equipment, medical equipment, accident prevention, anti-crime equipment, and/or safety equipment), it is necessary to verify whether the specifications of our products fit to such applications.
  Please ensure that you will ask and check with our inquiry desk as to whether the specifications of our products fit to such applications use before you use our products.
- The quality and performance of our products as described in this online catalog only apply to our products when used in isolation.
  Therefore, please ensure you evaluate and verify our products under the specific circumstances in which our products are assembled in your own products and in which our products will actually be used.
- If you use our products in equipment that requires a high degree of reliability, regardless of the application, it is recommended that you set up protection circuits and redundancy circuits in order to ensure safety of your equipment.
- The products and product specifications described in this online catalog are subject to change for improvement without prior notice.
  Therefore, please be sure to request and confirm the latest product specifications which explain the specifications of our products in detail, before you finalize the design of your applications, purchase, or use our products.
- The technical information in this online catalog provides examples of our products' typical operations and application circuits.
  We do not guarantee the non-infringement of third party's intellectual property rights and we do not grant any license, right, or interest in our intellectual property.
- If any of our products, product specifications and/or technical information in this online catalog is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially with regard to security and export control, shall be observed.

<Regarding the Certificate of Compliance the EU RoHS Directive/REACH Regulations>

- The switchover date for compliance with the RoHS Directive/REACH Regulations varies depending on the part number or series of our products.
- If you are not sure whether it applies to RoHS/REACH directive or not when using stock items, please do not hesitate to contact our sales representative.

- AEC-Q200 compliant

  The products are tested based on all or part of the test conditions and methods defined in AEC-Q200. Please consult with Panasonic for the details of the product specification and specific evaluation test results, etc., and please review and approve Panasonic's product specification before ordering.

We do not take any responsibility for the use of our products outside the scope of the specifications, descriptions, guidelines and precautions described in this online catalog.

85 years history of Panasonic resistors

Panasonic has produced resistors for more than 85 years.
Based on the concept, "Good products begin with Good components." by our founder Konosuke Matsushita, Panasonic started manufacturing fixed carbon film resistors for radio receivers in 1933 and reached the milestone of accumulative 2 trillion pieces production by 2013.
By lining up with this number of resistors, standard 1608 mm size, we can make a round trip to the moon (244,198 miles).

1933
Started manufacturing resistors

1966
Established Fukui Matsushita Electric Company

1974
Completed Morita factory

2003
Reached total 1 trillion pieces production

2013
Reached total 2 trillion pieces production

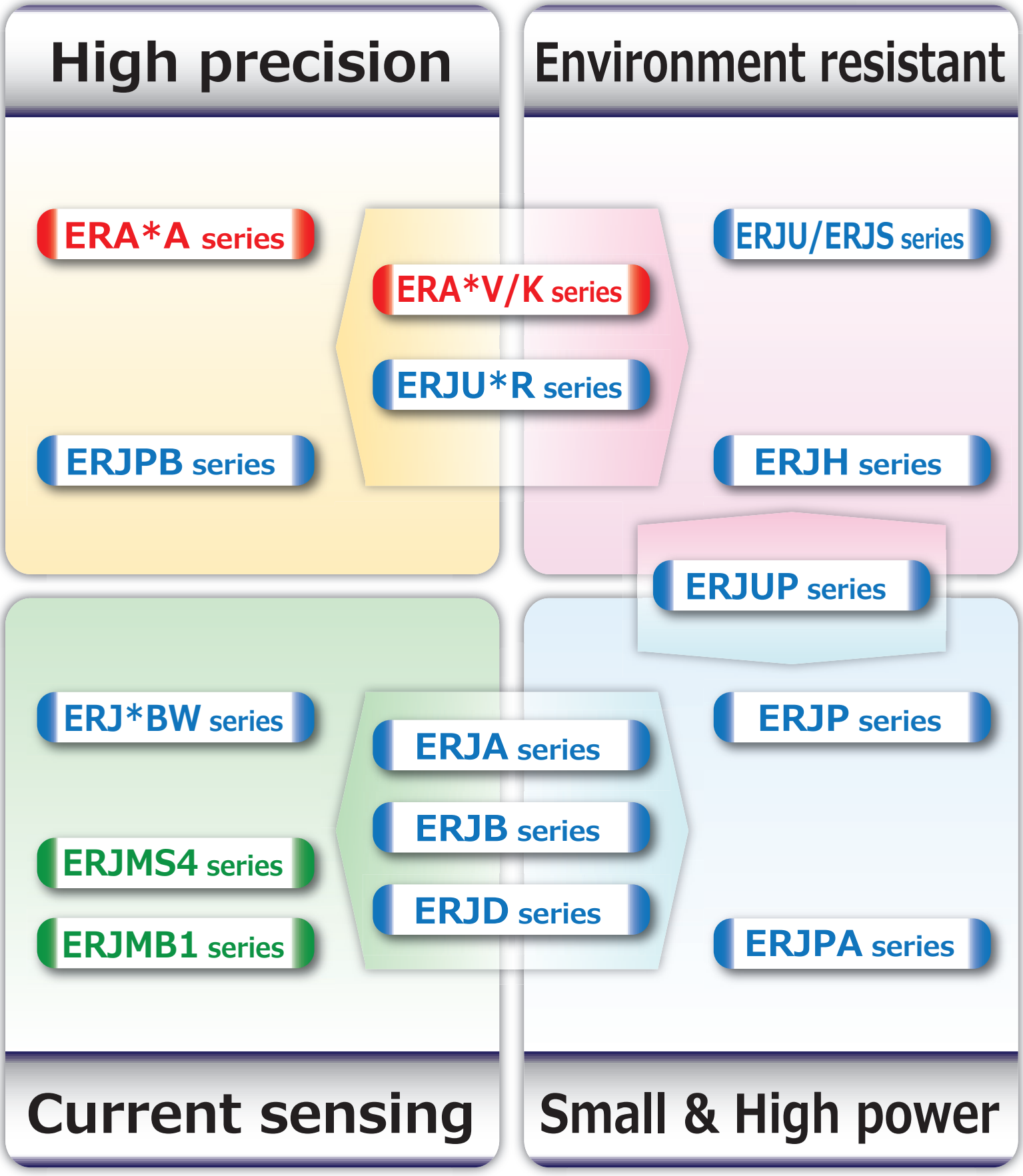
2018
85th Anniversary of production

INDEX

[Description of the icon]

- Down sizing : Reducing size what same power rating
- Anti-Surge : Improving durability for overloading
- High precision : Significantly reducing total resistance tolerance
- Anti solder joint crack : Reducing anti solder joint crack in heat cycle environment
- High power : Reaching higher power rating with same size
- Low TCR : Reducing variation of resistance value under temperature variation
- Anti-Sulfurated : Reducing variation of resistance value under sulfur environment
- High temperature : Reducing variation of resistance value under high temperature environment
- AEC-Q200 : Conforming AEC-Q200 grade 0 ＊ERJPA2 Grade 1

Panasonic chip resistors, product line-up



Thick film type

Thin film type

Metal plate type

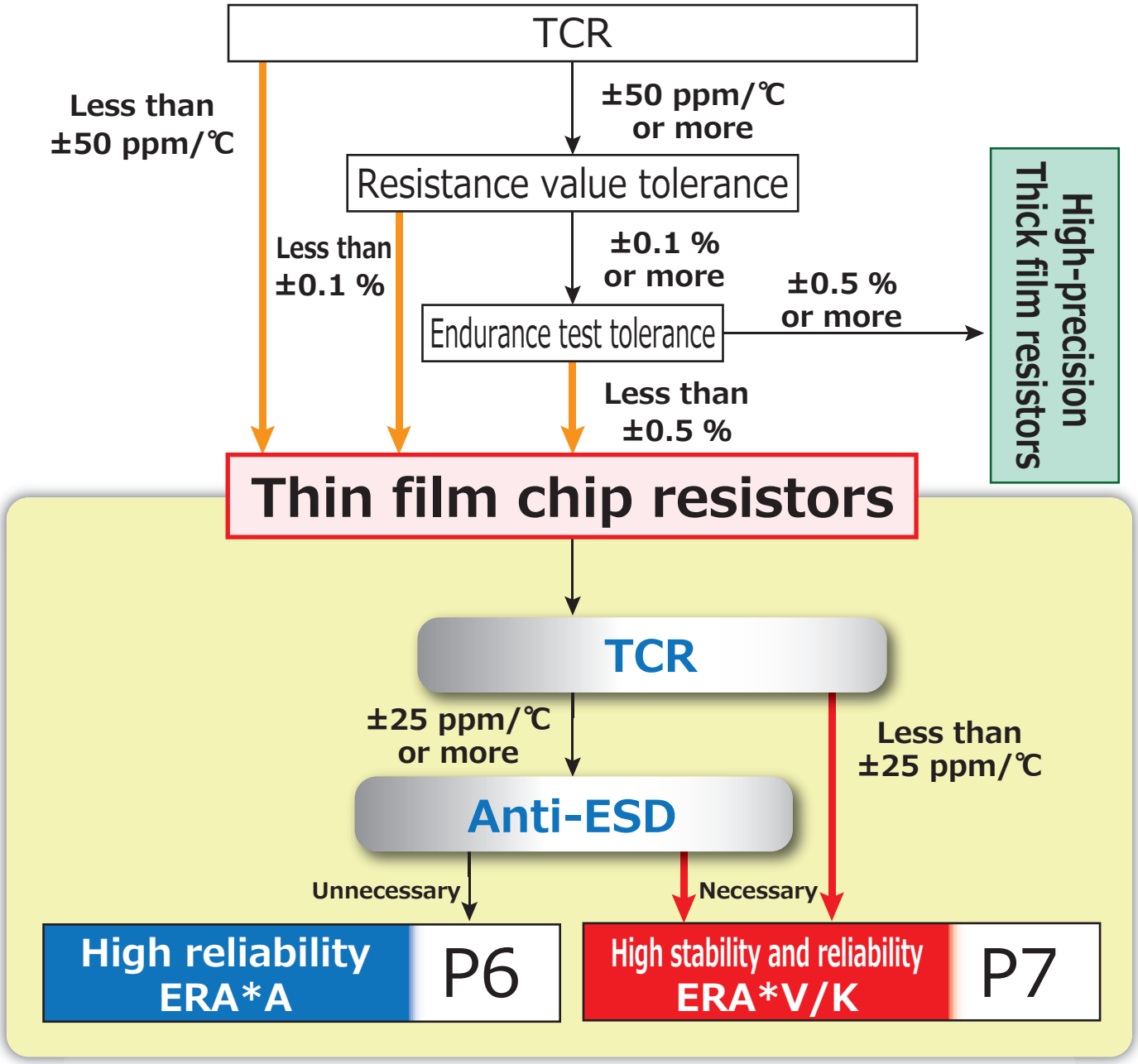
Proper Usage:
Thick film & Thin film chip resistors

Tolerance・TCR Matrix

TCR(ppm/℃) / Tolerance (%)	10	15	25	50	100	100 <
0.05					Thick film chip area	
0.1	ERA*V/K		ERA*A			
0.5						
1	Thin film chip area					
5						

*Our recommended combinations for Tolerance & TCR

Chip resistors selection guide



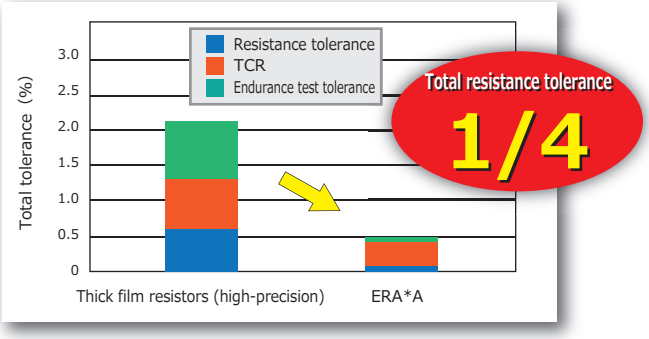
High precision
Thin film, High reliability type

High precision | Low TCR | Anti solder joint crack | AEC-Q200

ERA*A series

Reduce total resistance value by 1/4 from high-precision thick film resistors

- Resistance tolerance± 0.1 %
- TCR ± 25 ppm/℃
- Endurance test tolerance ± 0.1 %



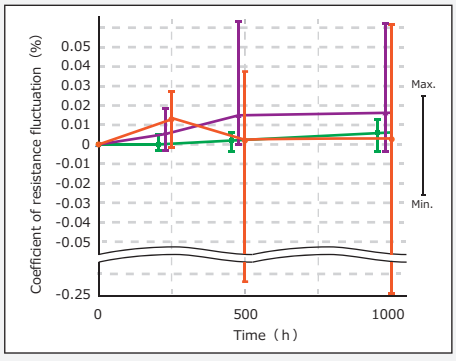
Quarter total tolerance from high-precision thick film resistors

1. Suppress deterioration of set's performance and reliability in long-term use and temperature change
2. Save design cost by design margin securing

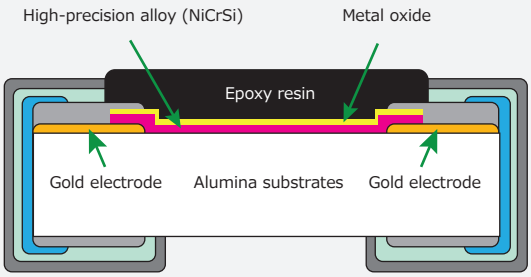
Point

Achieving high-precision (Endurance test tolerance ±0.1%) by original Ni & Cr & Si - High-precision resistance materials and protecting resistor by Sputter protection film.

● Endurance load test
(1 kΩ)
85℃, 85%RH,
Rated load
0603 Thin film resistors



● Structural drawing



■ Specifications

Part No.	Size (inch)	Power rating (W)	Limiting element voltage (V)	Resistance tolerance (%)	Resistance range (Ω)	TCR ($\times 10^{-6}$/℃)	Category temp. range (℃)	AEC-Q200
ERA1AEB	0201	0.05	25	± 0.1	100 to 10 k	± 25	-55 to 155	—
ERA2AEB	0402	0.063	50	± 0.1	47 to 100 k	± 25		Grade 1
ERA3AEB	0603	0.1	75	± 0.1	47 to 330 k	± 25		Grade 0
ERA6AEB	0805	0.125	100	± 0.1	47 to 1 M	± 25		
ERA8AEB	1206	0.25	150	± 0.1	47 to 1 M	± 25		

Please visit our website for details !

Click

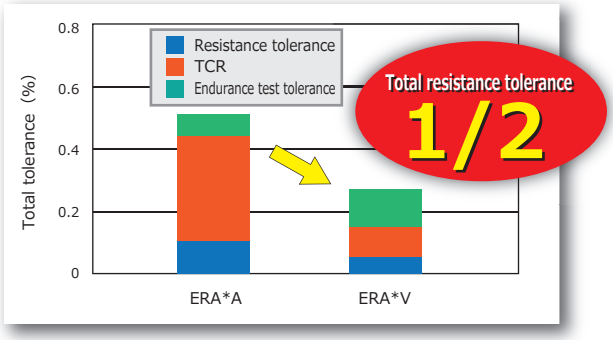
High precision
Thin film, High stability and reliability type

High precision | Low TCR | Anti solder joint crack
Anti-Sulfurated | Anti-Surge | AEC-Q200

ERA*V/K series

Achieving higher-precision and longer-life than conventional*1 series

- Resistance tolerance ± 0.05 %
- TCR ± 10 ppm/℃
- Endurance test tolerance± 0.1 %



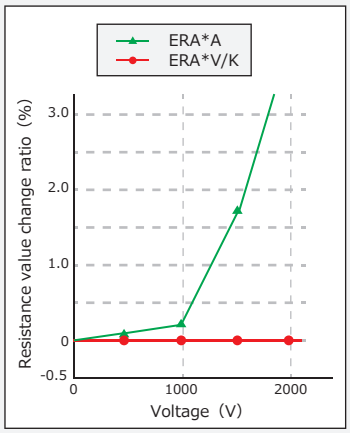
Half total tolerance from thin film chip resistors (Conventional series)

1. High-precision, design margin securing and improve performance
2. Improve reliability in severe conditions

Point **Highest level of ESD resistance by preventing current concentration and reducing electric field strength**

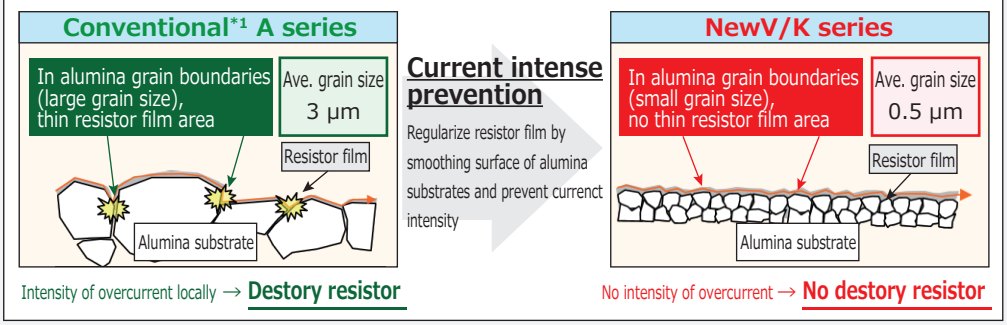
Anti-ESD

● ESD test (1 kΩ)
HBM : 150 pF,2 kV,±5 times
0603 Thin film chip resistors

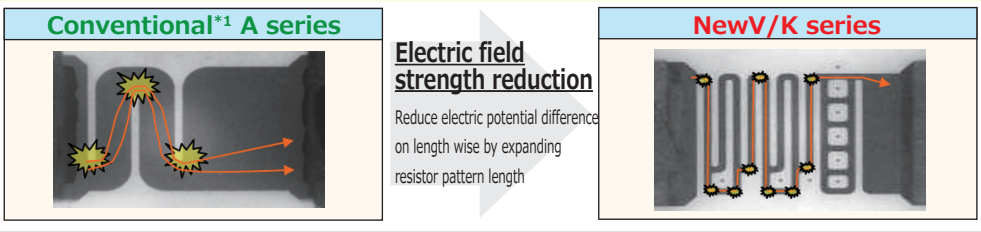


● Anti-ESD improved design

Resistor film thickness regularization



Expand resistor pattern length



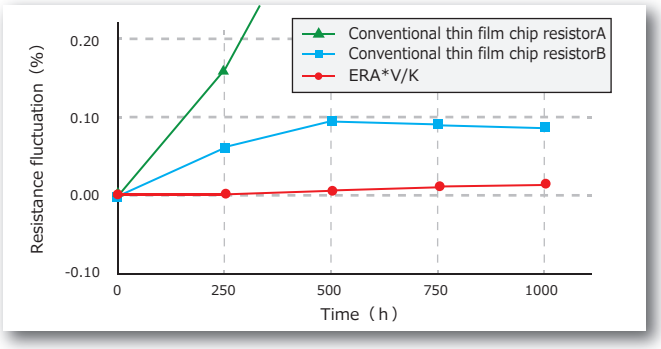
*1:ERA*A

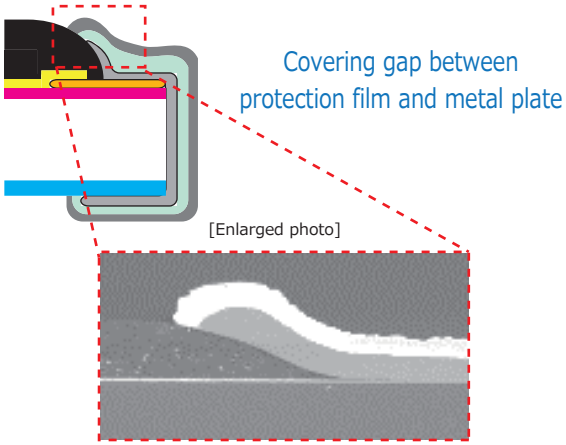
Point

Improve anti-sulfurated by the introduction of edge sputtering electrode covering gap between protection film and electrode

Anti-sulfurated

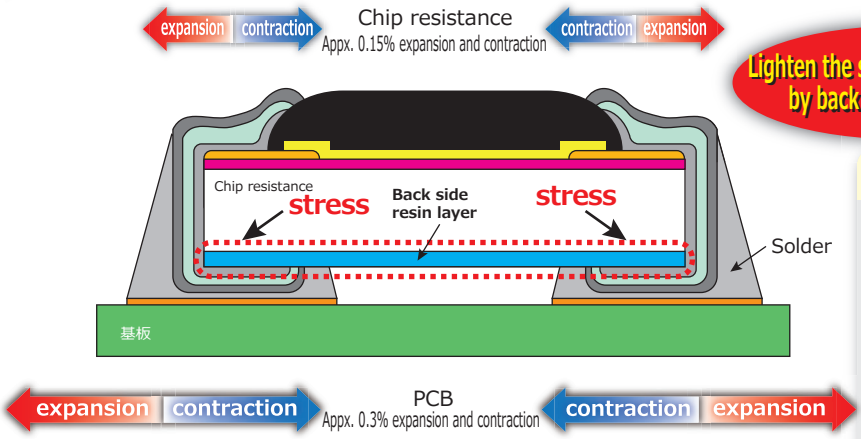
● Sulfurization gas test
ASTM B809 : 105 ℃ 0603 Thin film chip resistors

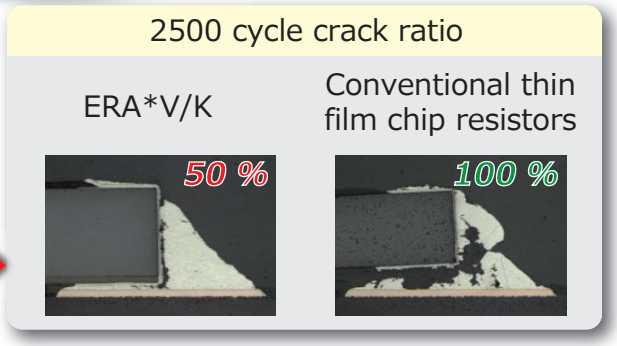




Point

Achieve excellent anti solder joint crack by back side resin layer





■ Specifications

Part No.	Size (inch)	Power rating (W)	Limiting element voltage (V)	Resistance tolerance (%)	Resistance range (Ω)	TCR (x10^{-6}/ ℃)	ESD withstand voltage (kV)	Category temp. range (℃)	AEC-Q200
ERA2V	0402	0.100	75	± 0.1 ±0.05	1 k ≦ R ≦ 47 k*1	±10(R) ±15(P)	1.0	-55 to 155	Grade 0
					47 ≦ R ≦ 100 k*1	±25(E)			
ERA3V ERA3K (100 kΩ over)	0603	0.125	100	± 0.1 ±0.05	1 k ≦ R ≦ 100 k	±10(R) ±15(P)	1.5		
					47 ≦ R ≦ 240 k	±25(E)			
ERA6V ERA6K (100 kΩ over)	0805	0.250	150	± 0.1 ±0.05	1 k ≦ R ≦ 100 k	±10(R) ±15(P)	2.0		
					47 ≦ R ≦ 750 k	±25(E)			
Under development ERA8V ERA8K (100 kΩ over)	1206	0.250	150	± 0.1 ±0.05	1 k ≦ R ≦ 100 k	±10(R) ±15(P)	2.0		
					47 ≦ R ≦ 1 M	±25(E)			

*1: Expanded resistance range

Please visit our website for details !

Click

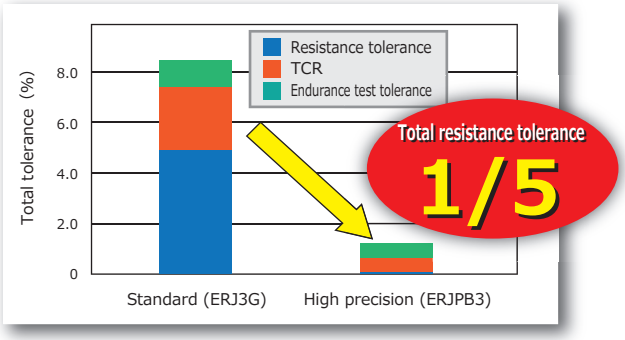
High precision
High precision thick film type

High precision | Low TCR | Anti solder joint crack | AEC-Q200

ERJPB series

Same tolerance level as thin film

- Resistance tolerance ± 0.1 %
- TCR ± 50 ppm/℃
- Endurance test tolerance ± 0.5 %

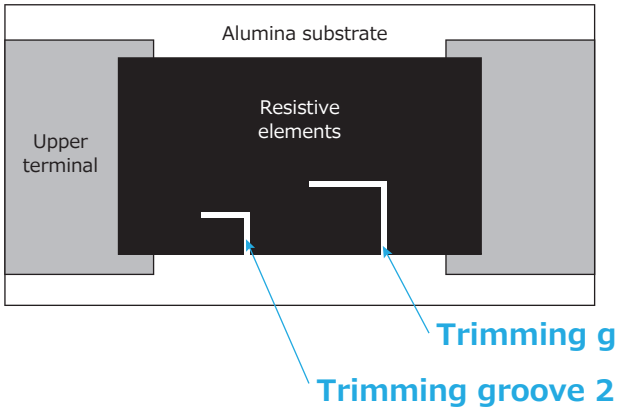


Cut the total tolerance to 1/5

1. Design margin securing
2. Improvement of reliability
3. Cost saving for IC by reducing correction circuit

Point

Achieved high precision resistance tolerance : ±0.1% by unique resistive material and trimming



By unique "Double L-shaped trimming" process, we can make slight adjustments of resistance value.
(2nd small L-shaped trimming has low adjustment rate)

■ Specifications

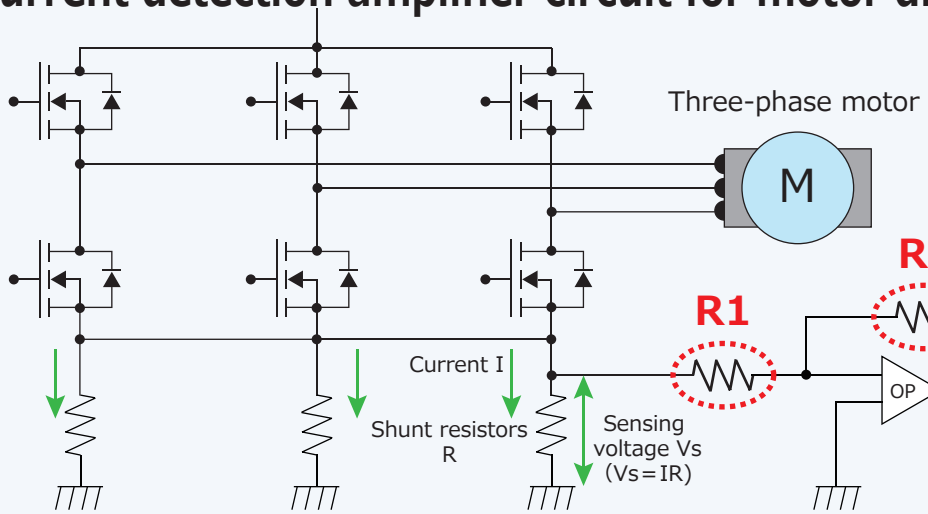
Part No.	Size (inch)	Power rating (W)	Limiting element voltage (V)	Resistance tolerance (%)	Resistance range (Ω)	TCR ($x10^{-6}$/ ℃)	Category temp. range (℃)
ERJPB3B	0603	0.20	150	± 0.1, ± 0.5	200 to 100 k	± 50	-55 ～ 155
ERJPB6B	0805	0.25	150	± 0.1, ± 0.5	200 to 1M	± 50	

Please visit our website for details !

Click

Application

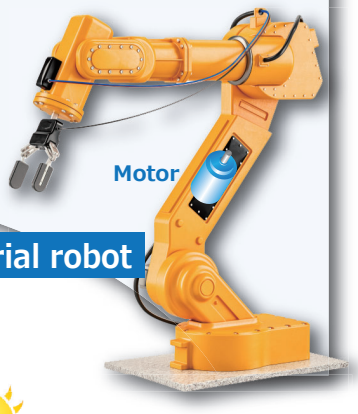
Application Example ①
Current detection amplifier circuit for motor drive control unit



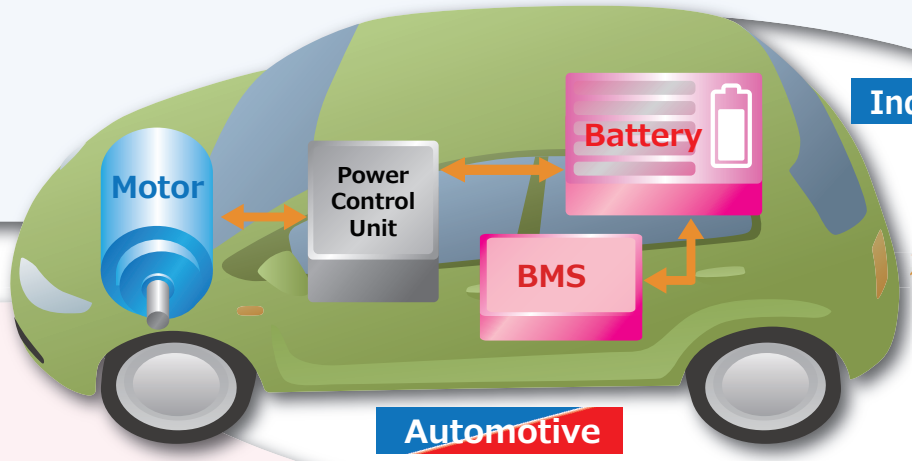
< Achieve high-precise amplifier ratio >

$$Vout = Vs \times \frac{R2}{R1}$$

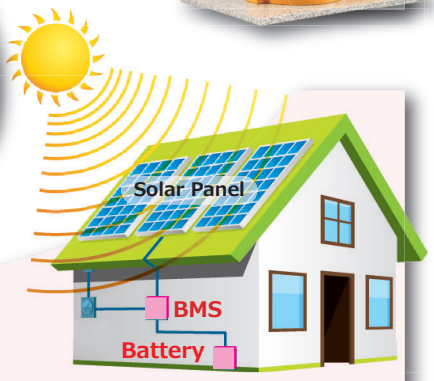
(amplification rate)



Industrial robot

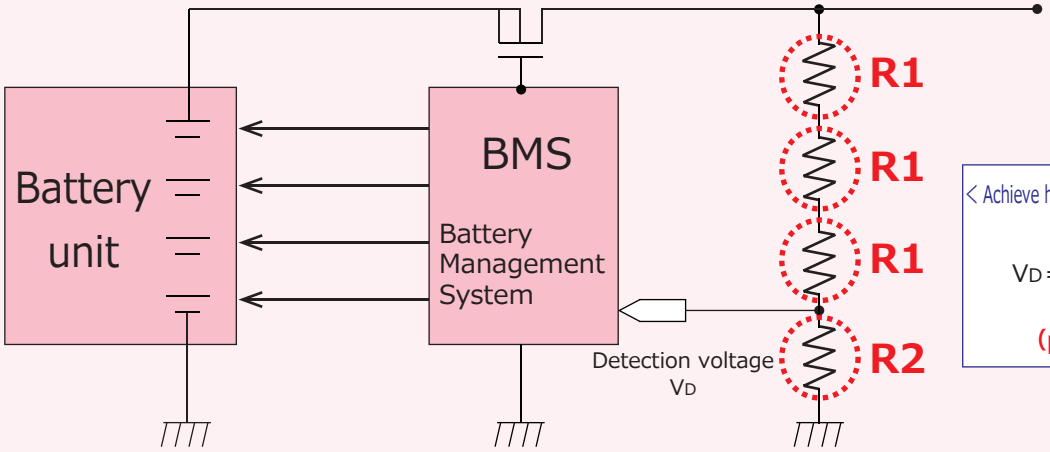


Automotive



Solar panels

Application Example ②
Voltage detection circuit for battery unit



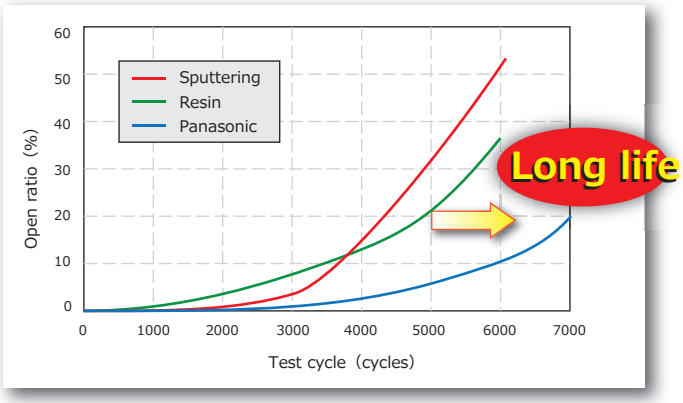
< Achieve high-precise partial pressure ratio >

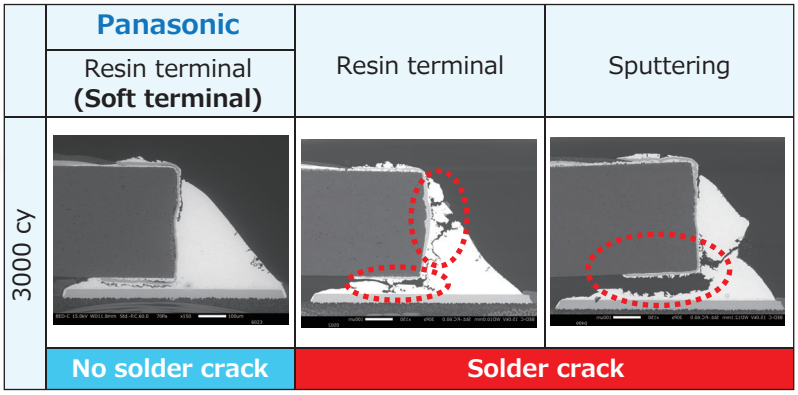
$$V_D = V \times \frac{R2}{(3R1+R2)}$$

(partial pressure ratio)

Anti solder joint crack

Reduces solder joint crack progression by originally developed soft terminal





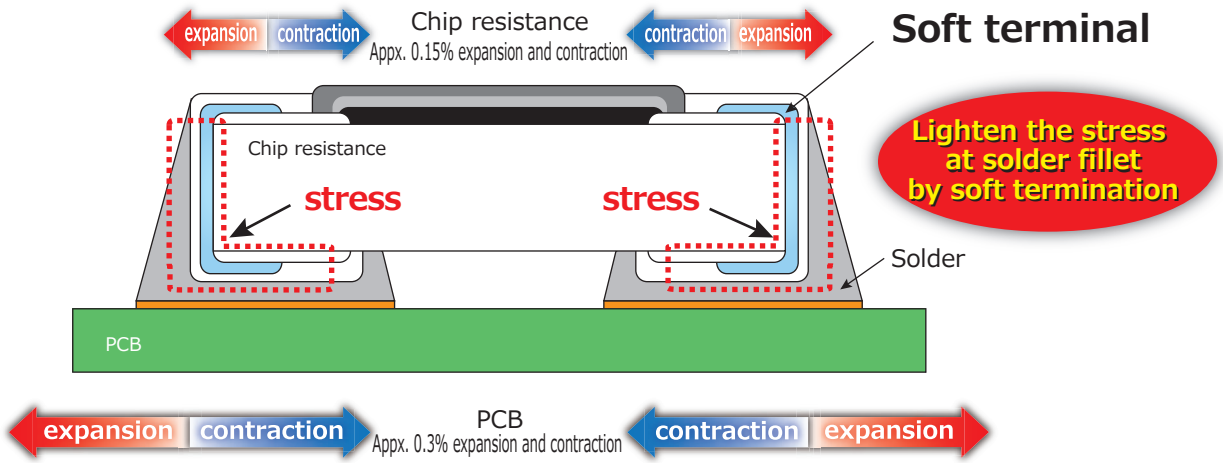
Reduce solder joint crack

1. Long life for the set of device
2. Improvement of reliability

Point

Soft termination technology adopted

◆ Cooling and heating cycle lightens the stress ◆



[Maintain exellent solder connection reliability even in harsh temperature environment such as for automotive.

Environment resistant
High temperature chip resistor

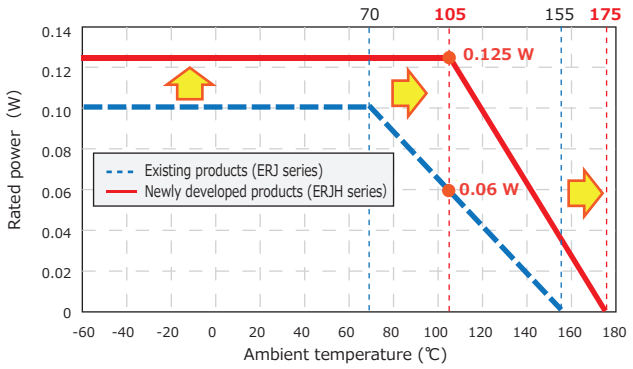
Down sizing | High power | High temperature | Anti solder joint crack | AEC-Q200

ERJH series

Achieves high heat resistance by new materials developing

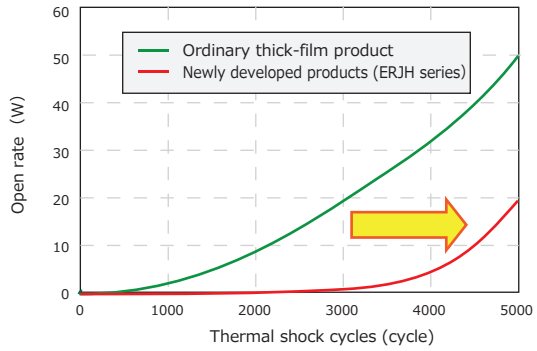
Expansion of maximum operating temperature and rated operating temperature

(Example) 0603 size Load reduction curve



Extended solder life by suppressing crack progress crack developing rate in thermal shock test

(Example)Test conditions : -55 ℃ /+175 ℃ 0603 size



Guarantees that the resistor endures 1000 cycles of thermal shock testing(-55℃/+175℃)

1. Expand of max operating temperature 155 ℃ ⇒ 175 ℃
2. Expand of rated operating temperature 70 ℃ ⇒ 105 ℃
3. Improvement of solder crack resistance

Point

Excellent high heat resistance due to both material flexibility and heat resistance

Overcome the trade-offs of conventional materials by reviewing the design of raw materials

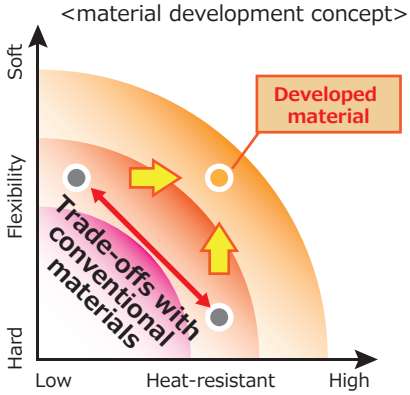
✓ Improvement of operating temperature

Max operating temp. : 175 ℃

Rated operating temp. : 105 ℃

✓ Suppression of solder cracks

<material development concept>



■ Specifications

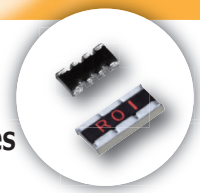
Part No.	Size (inch)	Power rating (W)	Resistance tolerance (%)	Resistance range (Ω)	Category temp. range (℃)
ERJH2	0402	0.10	± 0.5, ± 1, ±5	1 to 300 k	-55 to 175
ERJH3	0603	0.125			
ERJHP6	0805	0.50			

Please visit our website for details !

Click

Environment resistant
Anti-Sulfurated series

Anti-Sulfurated | Anti solder joint crack | AEC-Q200

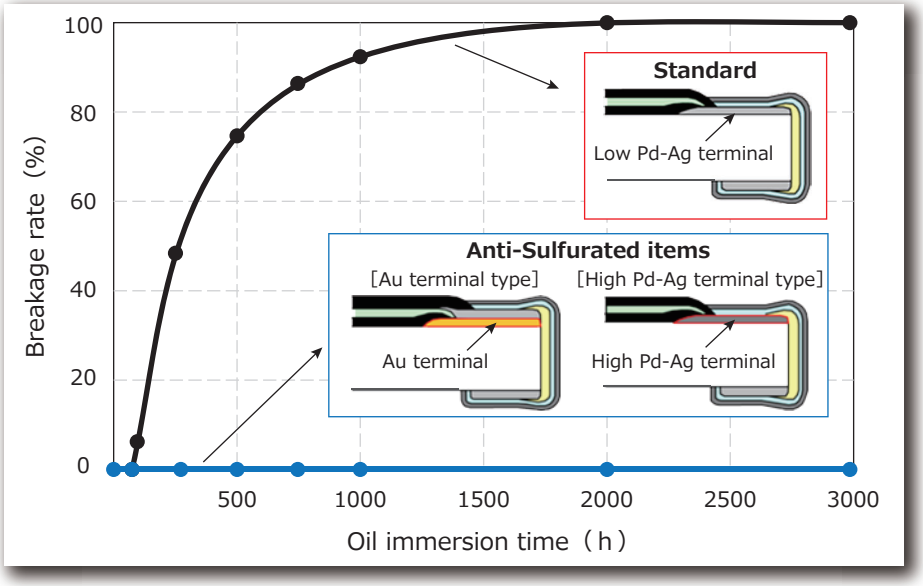


Standard : ERJS/U series
Array[*1] : EXBU series
High precision: ERJU*R series
Low resistance : ERJU*S/Q series
Small size & High power : ERJC/ERJUP series
Wide terminal : ERJC series

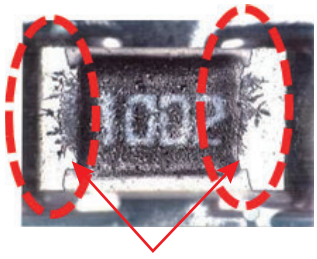
*1 : AEC-Q200 Grade 1

Anti-Sulfurated terminal reduces variation in the resistance value under harsh environment(sulfur)

● Sulfurized oil immersion test of chip resistors

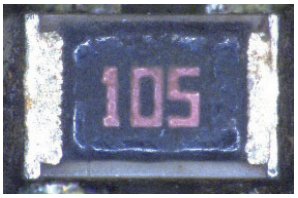


[Breakage in conventional items]

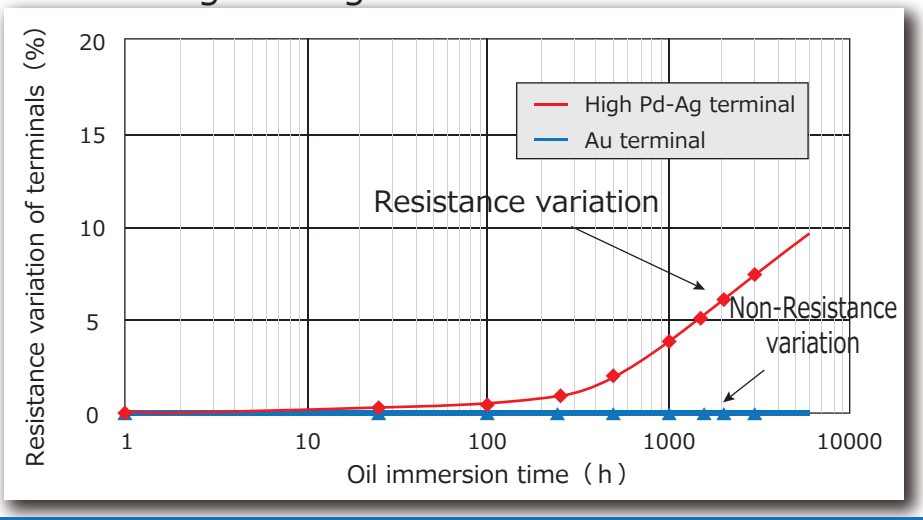


Sulfurated Ag needle crystal

[Non-Breakage in anti-sulfuraed items]



● Sulfurized oil immersion test of Au terminal and high Pd-Ag terminal



Covered with nickel plating layers, there is no anti-sulfurated characteristic difference between Au terminal and Pd-Ag terminal.

While Pd-Ag terminal has some variations in resistance value, Au terminal has very little variations in sulfurized oil immersion test.
It shows that Au terminal has higher anti-sulfurated characteristics of terminal itself.

With Anti-Sulfurated characteristics,

1. High reliability by reducing sulfurated breakage
2. Improve reliability of device at harsh environment
3. Cost reduction by unnecessary of sealing substrate

< Wide lineup of Anti-Sulfurated chip resistors with anti-sulfurated ctrode >

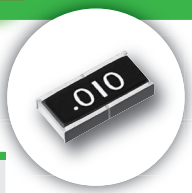
■ Chip resistor (standard size)

Type \ Size (inch)		0201	0402	0603	0805	1206	1210	2010 1020 (Wide terminal)	2512	Web catalog
Standard			ERJS02	ERJS03	ERJS06	ERJS08	ERJS14	ERJS1D	ERJS1T	Click
		ERJU01	ERJU02	ERJU03	ERJU06	ERJU08	ERJU14	ERJU1D	ERJU1T	
Precision			ERJU2R	ERJU3R	ERJU6R					Click
Small & High power				ERJUP3	ERJUP6	ERJUP8				Click
Low resistance (0.1 Ω to 10 Ω)					ERJU6S					Click
					ERJU6Q					
Array	2 resistors	EXBU14	EXBU24	EXBU34						Click
	4 resistors	EXBU18	EXBU28	EXBU38						
	8 resistors		EXBU2H							
Wide terminal	Low resistance (10 mΩ to 1 Ω)							ERJC1B		Click
								ERJC1C		

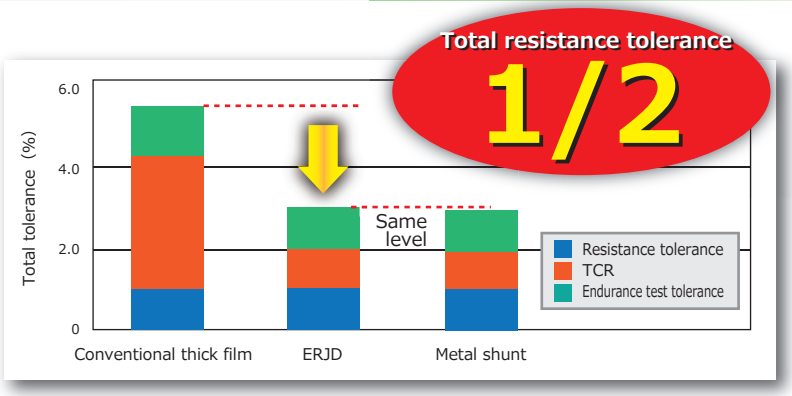
Current sensing
Low TCR high power / wide terminal type

Low TCR | Down sizing | High power | Anti solder joint crack | AEC-Q200

ERJD series



Achieved low-resistance/low-TCR
~ VA proposal for metal shunt resistors ~



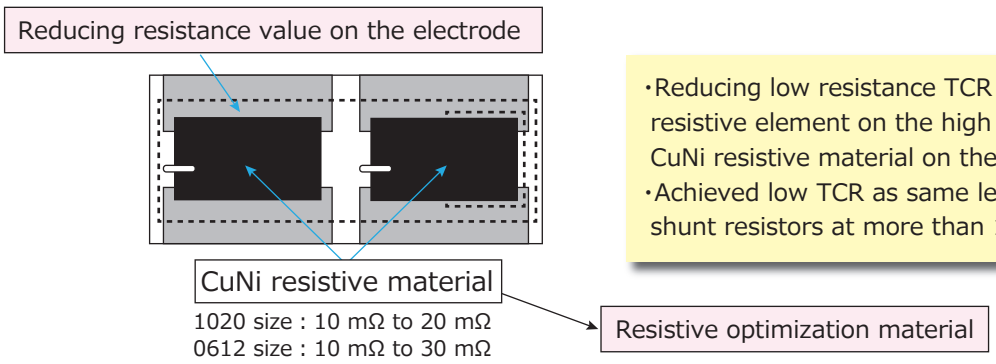
[Achieved TCR 350 ppm/℃ → 100 ppm/℃ in 10 mΩ]

Achieved same level performance as metal shunt resistor

1. Design margin securing
2. Improvement of reliability
3. Cost saving

Point

Achieved low resistance TCR by unique resistive material



・Reducing low resistance TCR by applying Pd-Ag resistive element on the high resistance value, CuNi resistive material on the low.
・Achieved low TCR as same level as metal shunt resistors at more than 10Ω.

■ Specifications

Part No.	Size (inch)	Power rating (W)	Resistance tolerance (%)	Resistance range (Ω)	TCR ($\times 10^{-6}$/℃)	Category temp. range (℃)
ERJD1	1020	2.0	± 1, ± 5	10 m to 200 m	± 100	-55 to 155
ERJD2	0612	1.0	± 1, ± 5	10 m to 200 m	± 100	

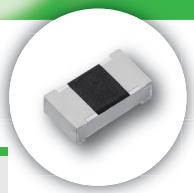
Please visit our website for details !

Click

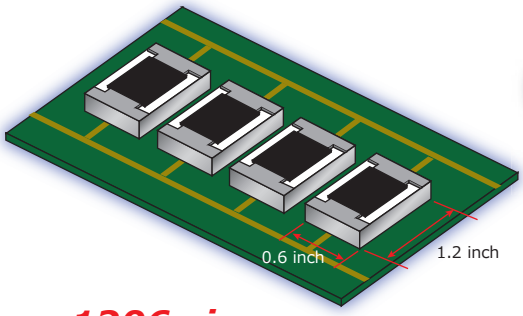
Current sensing
Double-sided resistive elements structure type

High power | Down sizing | Anti solder joint crack | AEC-Q200

ERJ*BW series

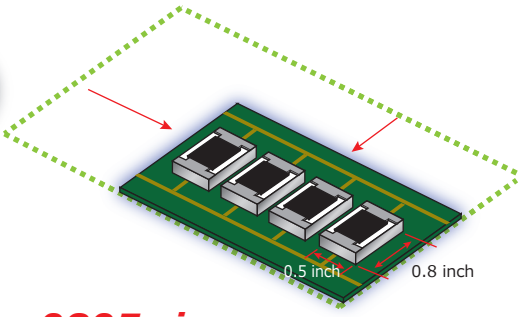


Small case size, low resistance, and high power by double-sided resistive elements structure



1206 size

PCB down sizing 45%



0805 size

[Achieved smaller case size(1206→0805) than conventional type for 10 mΩ]

PCB area reduction

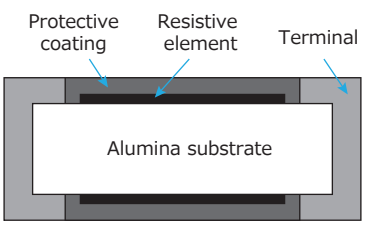
1. Down sizing　2. Weight saving　3. Cost saving

Point

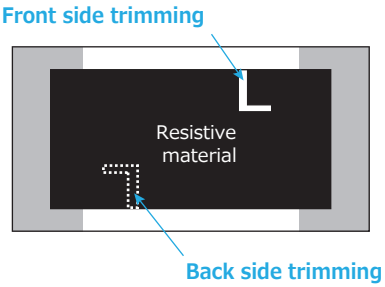
Realized small current sensing resistors by double-sided resistive elements structure

Double-sided resistive elements structure

[Side view]



[Top view]



- By original double sided resistive trimming "The front and back symmetrical double L-shaped trimming" process, load concentration can be avoided.
- Achieved small size & high power and overload characteristics.

■ Specifications

Part No.	Size (inch)	Power rating (W)	Resistance tolerance (%)	Resistance range (Ω)	TCR (x10^{-6}/ ℃)	Category temp. range (℃)
ERJ2BW	0402	0.25	± 1, ± 2, ± 5	47 m to 100 m	0 to +300	-55 to 155
ERJ3BW	0603	0.33	± 1, ± 2, ± 5	20 m to 200 m	20mΩ≦R<39mΩ : 0 to +250 39mΩ≦R≦100mΩ : 0 to +150	
ERJ6BW	0805	0.5	± 1, ± 2, ± 5	10 m to 100 m	10mΩ≦R<15mΩ : 0 to +300 15mΩ≦R≦100mΩ : 0 to +200	
ERJ8BW	1206	1.0	± 1, ± 2, ± 5	10 m to 100 m	10mΩ≦R<20mΩ : 0 to +200 20mΩ≦R<47mΩ : 0 to +150 47mΩ≦R≦100mΩ : 0 to +100	

Please visit our website for details !

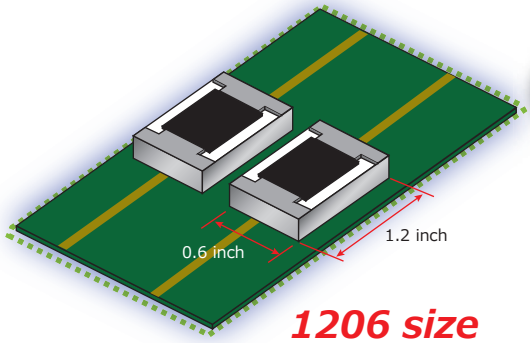
Click

Small size & High power
Anti-Surge type

Down sizing | High power | Anti-Surge | Low TCR | Anti solder joint crack | AEC-Q200

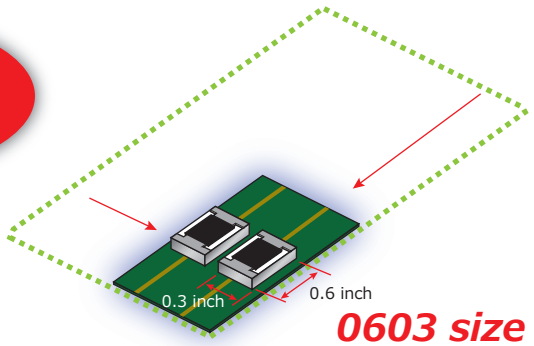
ERJPA/P0 series

Improvement of High power & Anti-Surge rating



1206 size

PCB down sizing **69%**



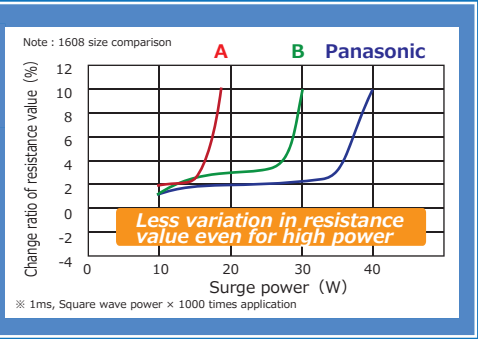
0603 size

PCB area reduction

1. Down sizing
2. Weight saving
3. Cost saving

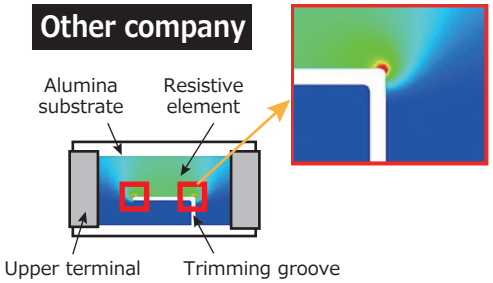
High Anti-Surge performance

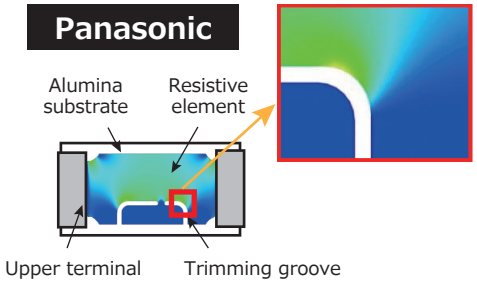
1. Failure reduction
2. Design margin securing



Point

Surge distribution by unique resistive material / trimming





- Unique “Double-C shaped trimming” for surge distribution.
- Achived small size & high power and overload characteristics.

■ Specifications

Part No.	Size (inch)	Power rating (W)	Limiting element voltage (V)	Resistance tolerance (%)	Resistance range (Ω)	TCR (x10^{-6}/ ℃)	Category temp. range (℃)
ERJPA2 (*1)	0402	0.20	50	± 0.5, ± 1	10 to 1 M	± 100	-55 to155
				± 5	10 to 1 M	± 200	
ERJPA3 (*2)	0603	0.25	150	± 0.5, ± 1	10 to 1 M	± 100	
				± 5	1 to 1.5 M	± 200	
ERJP06	0805	0.50	400	± 0.5, ± 1	10 to 1 M	R<33Ω : ± 300 33Ω≦R : ± 100	
				± 5	1 to 3.3 M	R<10Ω : - 100 to +600 10Ω≦R<33Ω : ± 300 33Ω≦R : ± 200	

*1 :ERJPA : AEC-Q200 Grade 1
*2 :Power rating up to 105 ℃

Please visit our website for details !

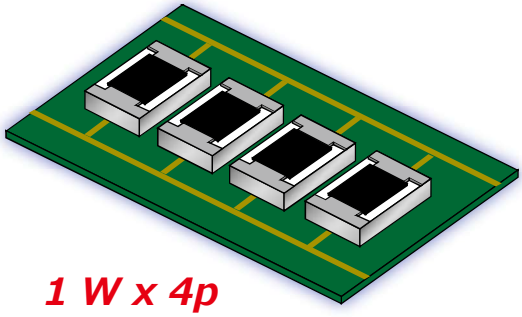
Click

Small size & High power
Wide terminal type

Down sizing | High power | Anti-Surge | Low TCR | Anti solder joint crack | AEC-Q200

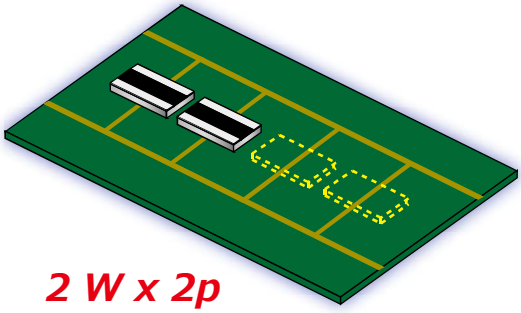
ERJB series

Improvement of High power & Anti-Surge rating



1 W x 4p

Number of pieces 50%



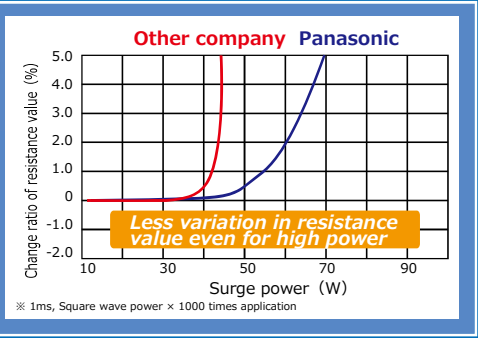
2 W x 2p

Number of pieces reduction

1. Down sizing
2. Weight saving
3. Cost saving

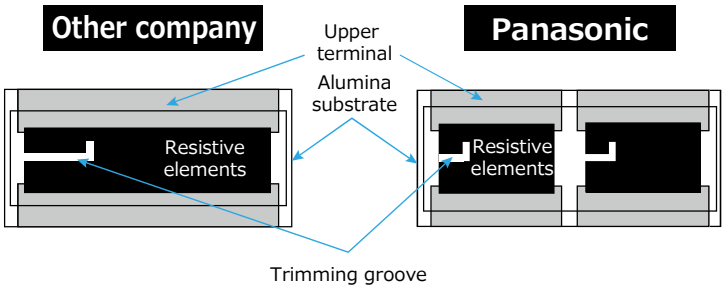
High Anti-Surge performance

1. Failure reduction
2. Design margin securing



Point

Higher power rating by wide termination structure with separated resistive elements



- Separated resistive elements for surge distribution.
- Achived small size & high power and overload characteristics.

■ Specifications

Part No.	Size (inch)	Power rating (W)	Limiting element voltage (V)	Resistance tolerance (%)	Resistance range (Ω)	TCR (x10^{-6}/ ℃)	Category temp. range (℃)
ERJB1	1020	2.0 (*2)	200	± 1	10 m to 10 k	R<22mΩ : 0 to +350 22mΩ≦R<47mΩ : 0 to +200 47mΩ≦R<100mΩ : 0 to +150 100mΩ≦R : ± 100	-55 to 155
ERJB2 (*1)	1632	1.0 (*3)	200	± 1	10 m to 10 M	R<22mΩ : 0 to + 350 22mΩ≦R<47mΩ : 0 to + 200 47mΩ≦R<100mΩ : 0 to + 150 100mΩ≦R<220mΩ : 0 to + 100 220mΩ≦R : ± 100	
ERJB3	1220	0.33	150	± 1	20 m to 10	R<47mΩ : 0 to + 300 47mΩ≦R<1Ω : 0 to + 200 1Ω≦R : ± 200	

*1:Power rating up to 105 ℃

*2:Resistance value 10.2 Ω or more, Power rating 1.0 W

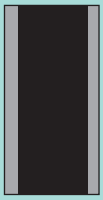
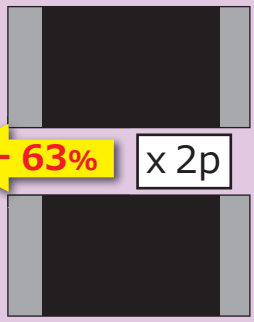
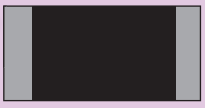
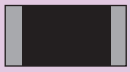
*3:Resistance value 10.2 Ω or more, Power rating 0.75 W

Please visit our website for details !

Click

Down sizing proposal

By the replacement with high power resistors from standard resistors,
" Panasonic contributes to make PCB smaller."

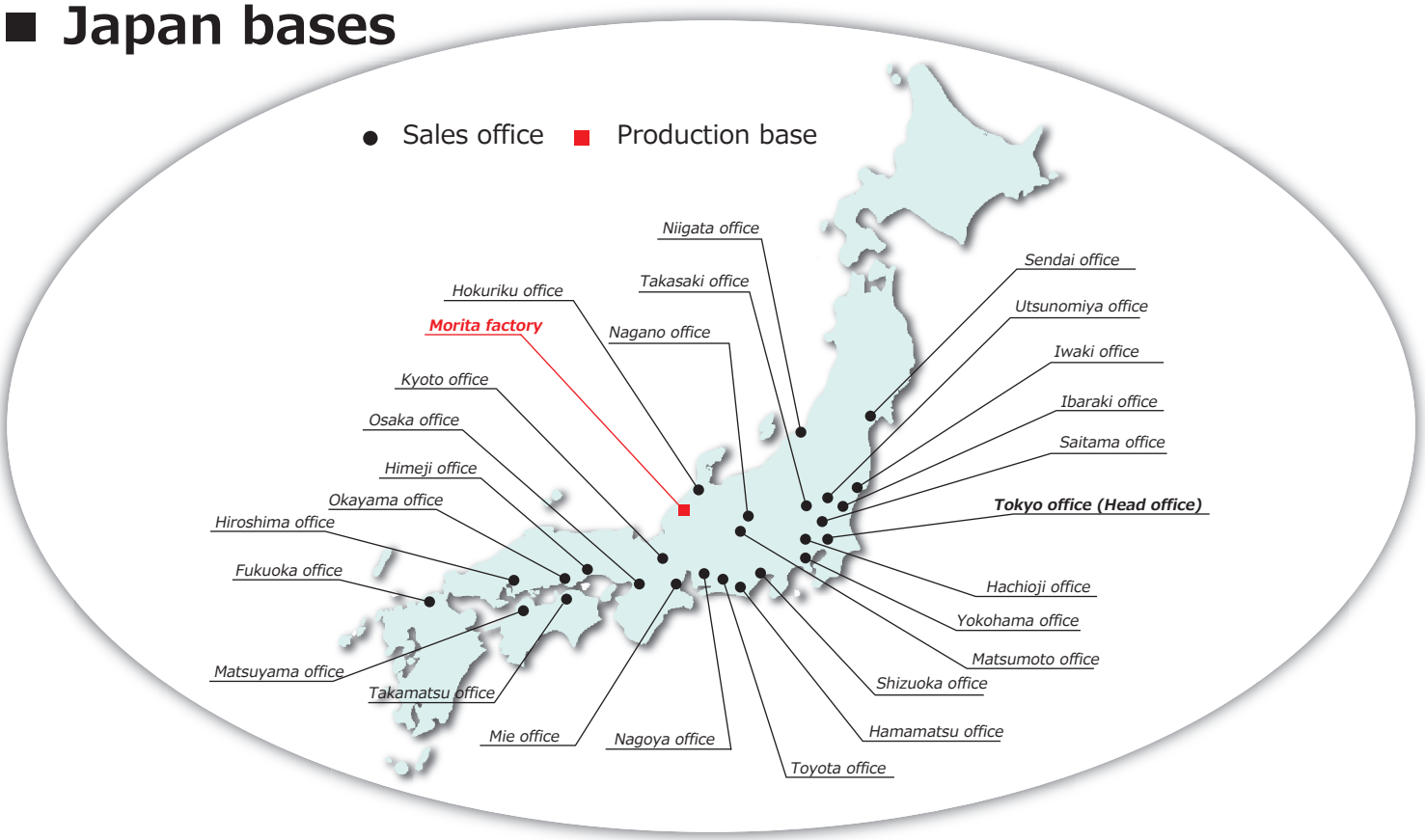
Power (W) \ Size (inch)	0402	0603	0805	1206 0612 (Wide terminal)	3225	2010 1020 (Wide terminal)	2512
2.0						ERJB1   − 63% x 2p	
1.0				ERJB2 	− 65%		
0.75					− 45%		
0.5			ERJP06 	− 65%			
0.25		ERJPA3 	− 69%				
0.2	ERJPA2 						
0.125		− 78%					

* " ← " means down sizing rate (%) of PCB.

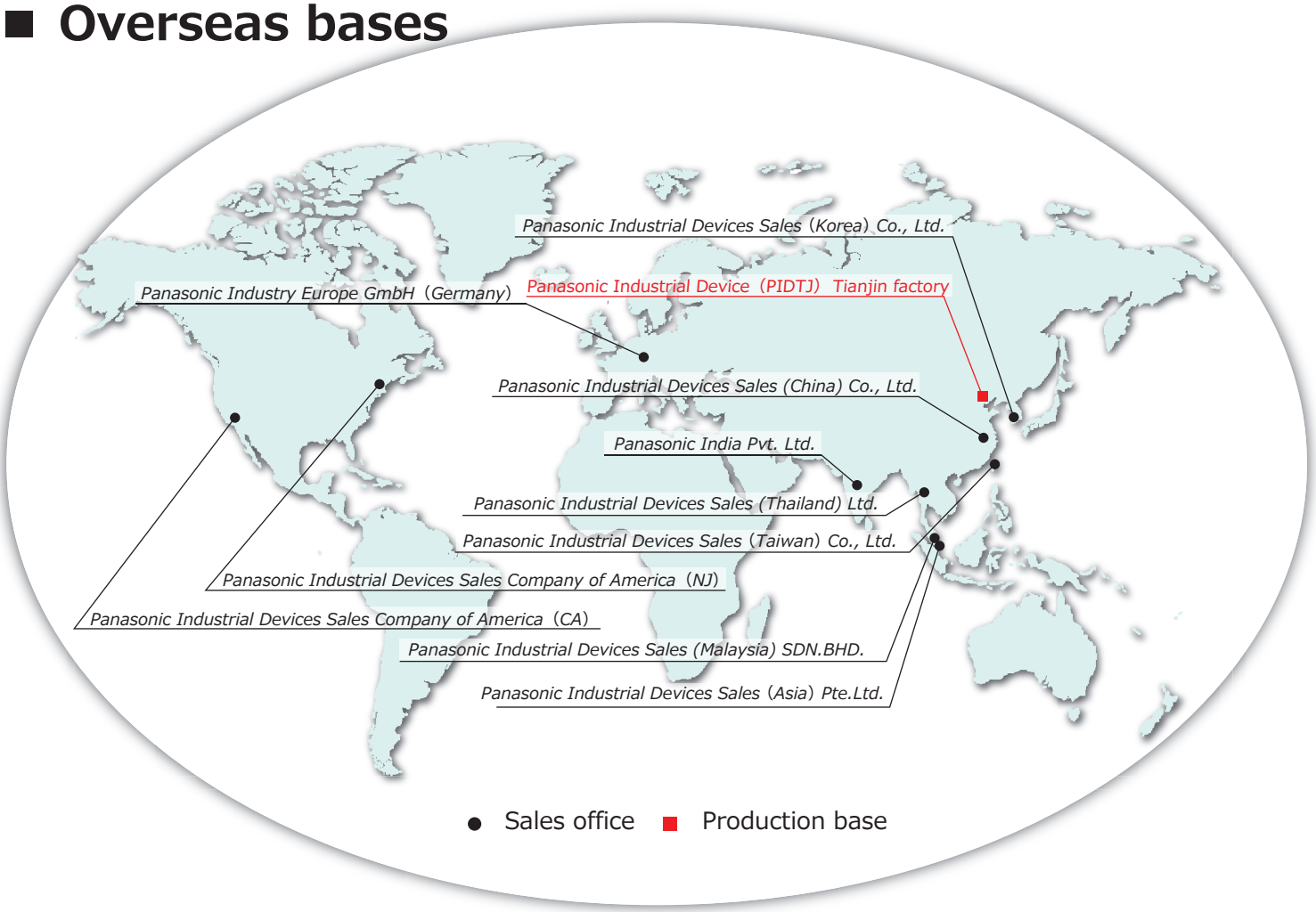
Panasonic | Standard

Main locations

■ Japan bases



■ Overseas bases



CAUTION AND WARNING

1. The electronic components contained in this catalog are designed and produced for use in home electric appliances, office equipment, information equipment,communications equipment, and other general purpose electronic devices.
   Before use of any of these components for equipment that requires a high degree of safety, such as medical instruments, aerospace equipment, disaster-prevention equipment, security equipment, vehicles (automobile, train, vessel),
   please be sure to contact our sales representative corporation.

2. When applying one of these components for equipment requiring a high degree of safety, no matter what sort of application it might be, be sure to install a protective circuit or redundancy arrangement to enhance the safety of your equipment. In addition, please carry out the safety test on your own responsibility.

3. When using our products, no matter what sort of equipment they might be used for, be sure to make a written agreement on the specifications with us in advance.

4. Technical information contained in this catalog is intended to convey examples of typical performances and or applications and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of our company or any third parties nor grant any license under such rights.

5. In order to export products in this catalog, the exporter may be subject to the export license requirement under the Foreign Exchange and Foreign Trade Law of Japan.

6. No ozone-depleting substances (ODSs) under the Montreal Protocol are used in the manufacturing processes of Automotive & Industrial Systems Company, Panasonic Corporation.

● Please contact

Thin / Thick film chip resistor

First edition : January 1, 2021

Revision : October 20, 2021

● Factory

Device Solutions Business Division
Industry Company

Panasonic

1006 Kadoma, Kadoma City, Osaka 571-8506, JAPAN

The information in this catalog is valid as of October 2021.